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Proposed Re-evaluation Decision PRVD2017-01

Chloropicrin

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Overview

What Is the Proposed Re-evaluation Decision?

After a re-evaluation of chloropicrin, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act* and Regulations, is proposing continued registration of products containing chloropicrin for sale and use in Canada.

An evaluation of available scientific information found that products containing chloropicrin do not present unacceptable risks to human health or the environment when used according to label directions. As a result of the re-evaluation, the PMRA is proposing label amendments to meet the current labelling standards. No additional risk reduction measures are proposed.

This Proposed Re-evaluation Decision follows risk reduction measures implemented in 2012 for chloropicrin to limit user exposure and to further protect the environment (Re-evaluation Notes REV2012-07, *Chloropicrin, Dazomet, Metam Sodium and Metam Potassium Label Improvements for Antimicrobial Products*, REV2012-08, *Chloropicrin, Dazomet, Metam Sodium and Metam Potassium Label Improvements for Soil Fumigant Products* and REV2012-09, *Label Amendments for Soil Fumigant Products Containing Chloropicrin*). The measures which were implemented in 2012 and came into force in 2014 were consistent with measures adopted by the United States Environmental Protection Agency (USEPA).

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for chloropicrin and presents the reasons for the proposed re-evaluation decision. The consultation document is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of chloropicrin.

This proposed decision affects all end-use products containing chloropicrin registered in Canada.

The PMRA will accept written comments on this proposal up to 90 days from the date of publication of this document. Please forward all comments to Publications (please see contact information indicated on the cover page of this document).

What Does Health Canada Consider When Making a Re-evaluation Decision?

The PMRA's pesticide re-evaluation program considers potential risks, as well as value, of pesticide products to ensure they meet modern standards established to protect human health *and* the environment.

Chloropicrin has been re-evaluated under Re-evaluation Program 1 as per Regulatory Directive DIR2001-03, *Pest Management Regulatory Agency Re-evaluation Program*. This program relies as much as possible on foreign reviews, typically USEPA Reregistration Eligibility Decision

[1] "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

(RED) documents. As such, the re-evaluation was based primarily on the USEPA RED[2] (2008), the amended RED[3] (2009), and the revised Human Health Risk Assessment for Chloropicrin[4] (2011).

In this proposed decision, the PMRA takes into account the Canadian use pattern and issues (for example, the federal Toxic Substances Management Policy). The PMRA compared the American and Canadian use patterns and found the USEPA assessments described in the RED documents were relevant to the Canadian situation. Additional risk assessments were conducted by the PMRA where deemed necessary.

The PMRA is aware that the USEPA opened their Registration Review docket for chloropicrin in 2013, and that the USEPA assessment of chloropicrin is ongoing.

What Is Chloropicrin?

In Canada, chloropicrin is a non-selective pre-plant soil fumigant used to control pathogens including insects, nematodes, bacteria, fungi and weeds in soil. In addition, chloropicrin is used as a remedial wood preservative to treat structural timber (such as poles).

Health Considerations

Can Approved Uses of Chloropicrin Affect Human Health?

Products containing chloropicrin are unlikely to affect human health when used according to label directions.

Potential exposure to chloropicrin may occur through diet (food and water), through bystander exposure, while working as a mixer/loader/applicator or by entering treated sites.

Extensive risk reduction measures have been implemented in Canada in 2012 to minimize exposure to workers and bystanders. These measures are expected to mitigate risks of concern for workers and bystanders. Risk from dietary exposure to chloropicrin is not of concern under current conditions of use.

Currently registered labels include the risk reduction measures required to minimize potential exposure to humans. No further risk reduction measures beyond those currently on the product labels are proposed.

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2 United States, 2008a.

3 United States, 2009a.

4 United States, 2011.

Environmental Considerations

What Happens When Chloropicrin Is Introduced into the Environment?

When used according to label directions, chloropicrin is not expected to pose risks of concern to the environment.

Chloropicrin enters the environment when applied as a soil fumigant and for remedial wood treatment. When applied as a fumigant, chloropicrin is injected into the soil and the soil is sealed to prevent its release. When applied for wood treatment, the environmental releases are expected to be minimal.

Once in the environment, chloropicrin will evaporate into the air and is easily broken down. Although chloropicrin has a potential to move through soil, available monitoring information shows that the levels in groundwater are minimal. Chloropicrin will not accumulate in the tissues of animals.

Chloropicrin does not present a risk of concern to wild mammals, birds, bees, invertebrates, freshwater or marine invertebrates, fish and amphibians. Currently registered labels include the risk reduction measures required to minimize potential exposure to non-target organisms and to protect aquatic environments from the potential effects from run-off. No further risk reduction measures beyond those currently on the product labels are proposed. Minor label amendments are proposed to meet current labelling standards.

Proposed Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human health and the environment. As a result of the re-evaluation of chloropicrin, the PMRA is proposing label amendments to meet current labelling standards (See Appendix III). No additional risk reduction measure is proposed.

What Additional Scientific Information Is Required?

There is no additional data requirement proposed under section 12 of the *Pest Control Products Act*.

Next Steps

Before making a final re-evaluation decision on chloropicrin, the PMRA will consider any comments received from the public in response to this consultation document. The PMRA will then publish a Re-evaluation Decision[5] that will include the decision, the reasons for it, a summary of comments received on the proposed decision and the PMRA's response to these comments.

[5] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

Science Evaluation

1.0 Introduction

Following the re-evaluation announcement for chloropicrin, the registrant of the technical grade active ingredient in Canada indicated that they intended to provide continued support for all uses included on the labels of restricted class and commercial end-use products in Canada.

The PMRA implemented risk reduction measures in 2012 to limit user exposure and to further protect the environment (Re-evaluation Notes REV2012-07, *Chloropicrin, Dazomet, Metam Sodium and Metam Potassium Label Improvements for Antimicrobial Products*, REV2012-08, *Chloropicrin, Dazomet, Metam Sodium and Metam Potassium Label Improvements for Soil Fumigant Products* and REV2012-09, *Label Amendments for Soil Fumigant Products Containing Chloropicrin*). The measures implemented in 2012 were consistent with measures adopted by the United States Environmental Protection Agency[6,7] for chloropicrin. These measures came into force in Canada in September 2014.

Chloropicrin was re-evaluated under Re-evaluation Program 1 as per Regulatory Directive DIR2001-03, *Pest Management Regulatory Agency Re-evaluation Program*. As such, the re-evaluation was based primarily on the USEPA RED (2008), the amended RED (2009) and the revised Human Health Risk Assessment for Chloropicrin[8] (2011). Additional risk assessments were conducted by the PMRA where deemed necessary.

In March 2017, PMRA completed a special review of chloropicrin (REV2017-04). This special review was based on the non- approval of chloropicrin in the European Union. The aspects of concern that prompted the special review were identified as potential risks to handlers, the potential for chloropicrin to leach to groundwater, the potential for long-range atmospheric transport, and potential risk to birds, mammals and aquatic organisms. After evaluation of available relevant scientific information related to the aspects of concern, the PMRA confirmed the current registration of chloropicrin products for sale and use in Canada.

2.0 Description of Registered Chloropicrin Uses

Chloropicrin is a non-selective pre-plant soil fumigant used to control pathogens including insects, nematodes, bacteria, fungi and weeds. In addition, chloropicrin is used as a remedial wood preservative to treat structural timber (such as poles).

Five products containing chloropicrin are currently registered in Canada (Appendix I): one technical grade active ingredient, one commercial class product and three restricted class products.

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6 United States, 2008a.

7 United States, 2009a.

8 United States, 2011.

The restricted class products are registered for pre-plant soil fumigation. Chloropicrin is currently registered for use in soil where the following crops will be planted: tobacco, strawberry, raspberry, tomato, peppers, root and tuber vegetables (crop group 1), strawberry runners and ornamental and forest nurseries. The end-use products are formulated as pressurized liquids or solutions.

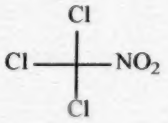
In soil fumigation, chloropicrin is applied by injection into soil using ground equipment at a minimum of 20 cm from the soil/air interface. Tillage discs or bed shapers are used immediately behind the injection point to seal the soil and remove the chisel trace. Applications are either broadcast (that is, the whole field is treated) or banded (that is, only strips, rows or beds are treated). The fumigant is then further sealed in the soil after application by compaction, wetting down the treated area, or covering with a tarp.

The commercial class end-use product is registered for the remedial wood preservation of structural timber (such as poles). The end-use product is a pressurized liquid which is injected into pre-drilled holes, and then sealed with treated wood plugs.

All current uses are being supported by the technical registrant and were, therefore, considered in the re-evaluation of chloropicrin.

3.0 The Technical Grade Active Ingredient, Its Properties

3.1 Identity of the Technical Grade Active Ingredient

Common name	Chloropicrin
Function	Insecticide, nematicide, bactericide, fungicide, herbicide
Chemical name	
1 **International Union of Pure and Applied Chemistry (IUPAC)**	Trichloronitromethane
2 **Chemical Abstracts Service (CAS)**	Trichloronitromethane
CAS Registry Number	76-06-02
Molecular formula	CCl_3NO_2
Structural formula	
Molecular weight	164.4
Purity of the technical grade active ingredient	99%

Based on the manufacturing process used, impurities of human health or environmental concern as identified in the Canada Gazette, Part II, Vol. 142, No. 13, SI/2008-67 (2008-06-25), including TSMP Track 1 substances, are not expected to be present in the product.

3.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Property	Result
Vapour pressure	3.2×10^6 mPa
Ultraviolet–visible spectrum	Not expected to absorb at >300 nm)
Solubility in water	1620 mg/L
***n*-Octanol–water partition coefficient at 20 °C (pH 7)**	Log K_{ow}= 2.5
Dissociation constant	Not applicable (no dissociable functionality)

4.0 Impact on Human Health

Exposure to chloropicrin may occur through consumption of food and water, through bystander exposure, while working as a mixer/loader/applicator or by entering treated sites.

4.1 Toxicology Summary and *Pest Control Products Act* Hazard Considerations

Chloropicrin is highly acutely toxic via the oral, inhalation and dermal routes, and is a skin and eye irritant. Chloropicrin was not tested for dermal sensitization since it is corrosive to the skin.

Chloropicrin is a sensory irritant which stimulates the trigeminal nerve mediating sensations in the nose, eyes, throat, and upper respiratory tract. Animal studies indicate that repeat exposures may result in nasal and lung effects. Chloropicrin is not considered to be a carcinogen.

The toxicological endpoints used for assessing risk to human health are summarized in Appendix II.

Based on a review of available information, the chloropicrin database contains the full complement of required studies including a reproductive inhalation study in rats, and developmental toxicity (inhalation) studies in rats and rabbits. The toxicological endpoints used for risk assessment are expected to be protective of potential effects on the young.

4.2 Occupational Exposure and Risk Assessment

Workers can be exposed to chloropicrin as a chemical handler (that is, persons involved in the application of chloropicrin) and as a non-handler (persons conducting post-application activities). Due to the volatile nature of chloropicrin, the major route of occupational exposure is inhalation.

4.2.1 Soil fumigation

4.2.1.1 Handler Exposure and Risk

Soil fumigant "handlers" are considered any persons involved in the use of the product. This includes: loading/applying the product, perforating/removing tarps, cleaning spills, as well as handling, cleaning, and/or repairing machinery or containers.

Based on the conditions of use (in other words, injection into soil), dermal exposure to chloropicrin is expected to be minimal. However, given the corrosive nature of chloropicrin, relevant hazard and precautionary statements as well as a requirement of personal protective equipment are implemented on current end-use product labels to protect handlers from any potential contact with liquid.

Based on the current use pattern, acute (less than 24 hrs), short-term (1-30 days) and intermediate-term (1-6 months) inhalation exposure is expected.

Extensive risk reduction measures were implemented in Canada to minimize handler inhalation exposure to chloropicrin (REV2012-09). These measures include mandatory good agricultural practices (GAPs), which include restrictions regarding site conditions (for example, weather, soil temperature, soil moisture) and practices to be followed during application (for example, soil preparation and soil sealing), are expected to reduce chloropicrin emissions from treated fields, and thus, reduce potential handler exposure. Additional requirements include:

- site-specific fumigation management plan required for each application (see Section 4.2.1.2);
- mandatory certification or licensing required for all soil fumigant handlers (to ensure that handlers are aware of the potential risks associated with the use of the product and of the importance of following label directions);
- inclusion of respirator protection and stop work triggers on the label; and
- at least two fumigant handlers to be present at all times to monitor one another.

All labels also have relevant hazard statements and warning/precautionary directions. Further, the measures require training, detection and response systems to be in place should an accident or spill occur. Together, all of these measures are expected to limit soil fumigant handler exposure to chloropicrin.

Based on the above, the PMRA has determined risks to handlers from soil fumigant use are not of concern based on the current conditions of use; therefore, no additional risk reduction measures are proposed.

4.2.1.2 Postapplication Exposure and Risk

Re-entry workers can be exposed to chloropicrin released from treated soil. Based on the current conditions of use, the greatest potential for inhalation exposure to non-handlers is shortly after application or following tarp perforation and/or removal. Dermal exposure to residues after the product is applied is not expected. Since chloropicrin is typically applied only once per year, occupational postapplication exposure is expected to be of short-term duration.

Extensive risk mitigation measures were implemented in Canada to minimize the potential for occupational postapplication exposure to chloropicrin (REV2012-09), and are currently included on the product labels:

- mandatory GAPs to reduce emissions from treated fields (see Section 4.2.1.1);
- restrictions pertaining to re-entry into fumigated fields (that is, restricted-entry intervals);
- notification of workers and fumigation application posting on all entrances of the application block prior to chloropicrin soil fumigation;
- buffer zone requirements for every fumigant application (see Section 4.3.1.1);
- site-specific Fumigation Management Plan, which covers key steps including:
    - monitoring of site/soil conditions;
    - following the mandatory GAPs;
    - fumigant air monitoring; and emergency response planning).

Together, these measures are expected to limit the potential for occupational postapplication exposure to chloropicrin. Further, based on the use pattern typical re-entry activities are generally not expected to occur for at least 10 to 14 days following the completion of the application.

Overall, the PMRA has determined that potential occupational postapplication risks from the use of chloropicrin as a soil fumigant are not of concern based on the current conditions of use; therefore, no additional risk reduction measures are proposed.

4.2.2 Remedial Wood Preservation

For remedial wood treatment of structural timber (such as poles), chloropicrin is injected into pre-drilled holes and immediately sealed with treated wood plugs.

Risk reduction measures are currently included on the product label to minimize handler exposure to chloropicrin. As such, personal protective equipment (PPE), including long pants, a long-sleeved shirt and chemical-resistant gloves is currently required on the product label. Handlers are also required to wear a full face respirator during the injection (or pouring) into pre-drilled holes. In addition, directions for use statements, including a prohibition of indoor use and instructions on spill procedure (that is, entry into the spill or clean-up area by unprotected persons is prohibited until the air concentration of chloropicrin is measured to be less than 0.15 ppm) are currently included on the product label.

Workers are not expected to be exposed to chloropicrin following the treatment of structural timber since holes are plugged after application, and because exposure of workers remaining in the vicinity of the treated poles or having direct contact with treated poles would occur infrequently.

Under current conditions of use, occupational handler and postapplication exposure to chloropicrin used for remedial wood preservation is expected to be minimal, and risk not of concern. No additional risk mitigation measure is proposed.

4.3 Non-Occupational Exposure and Risk Assessment

There are no domestic end-use products currently registered for chloropicrin. Non-occupational exposure to chloropicrin may occur through consumption of food and water. Based on chloropicrin's high volatility, there is also a potential for residential bystander inhalation exposure from fields treated with chloropicrin, and for residential postapplication inhalation exposure from treated wooden poles.

4.3.1 Residential/Bystander Exposure

4.3.1.1 Soil Fumigation

Chloropicrin released from treated soil following application can move off-site to non-target areas and result in residential bystander exposure. Since chloropicrin is typically applied once per year, bystander exposure is expected to be of acute/short-term duration.

Extensive risk reduction measures were implemented in Canada to minimize bystander inhalation exposure to chloropicrin, and are currently included on the product label (REV2012-09). These measures include:

- mandatory GAPs to reduce emissions from treated fields (see Section 4.2.1.1);
- maximum application rate reductions;
- site-specific Fumigation Management Plan (see Section 4.2.1.2), and
- the requirement of a buffer zone for every fumigant application (see below).

Buffer zones provide distance between the application site and bystanders, allowing airborne residues to disperse before reaching bystanders. All non-handlers, including nearby residents, pedestrians, and other bystanders, must be excluded from the buffer zone during the Buffer Zone Period (which lasts a minimum of 48 hours after application), except for transit (vehicular and bicycle traffic) through the buffer zone. The size of the required buffer zone is determined by the application rate, field size, application method and credits for use of emission-reduction measures.

Together, all of these measures are expected to limit the potential for bystander exposure to chloropicrin.

In consideration of the implemented risk reduction measures, the PMRA has determined that risks to bystanders are not of concern based on the current conditions of use. No additional mitigation measure is proposed.

4.3.1.2 Remedial Wood Preservation

Mitigation measures were implemented in Canada to minimize the potential for bystander exposure to chloropicrin when used for remedial wood treatment, and are currently included on the product label (REV2012-07). As such, the product label requires that the pre-drilled holes are plugged immediately after application. In addition, the label prohibits the treatment of structures/breams indoors, as well as entry into spill or clean-up area by unprotected persons until the air concentration of chloropicrin is measured to be less than 0.15 ppm. Finally, the product label includes Direction for Use instructions to ensure that chloropicrin is contained within the pole and will not be released into the environment through checks and cracks.

Based on the above, the potential for bystander exposure to chloropicrin, from its use as a remedial wood preservative, is expected to be minimal and the risk not of concern under the current conditions of use. No additional risk reduction measure is proposed.

4.3.2 Dietary Exposure and Risk

4.3.2.1 Exposure from Food

Dietary exposure to chloropicrin could occur from use as a pre-plant soil fumigant. Refined acute and chronic dietary risk assessments were conducted using half of the limit of quantification (LOQ) values for chloropicrin residues in all crops as there is no expectation of finite residues in crops following a soil fumigation treatment with chloropicrin. Animal matrices were not included in the refined acute and chronic dietary exposure assessments (in other words, since there is no expectation of chloropicrin residues in treated crops, transfer of residues in meat, milk and eggs from animals consuming treated feed is expected to be minimal).

The results of the dietary assessment indicate that risk from acute and chronic dietary exposures to chloropicrin from food is not of concern for the general population and all population subgroups.

4.3.2.2 Exposure from Drinking Water

Drinking water exposure to chloropicrin could occur from use as an outdoor pre-plant soil fumigant.

4.3.2.2.1 Soil Fumigation

To assess the potential exposure to groundwater, the PMRA considered available groundwater monitoring data, particularly a review of monitoring data from California and Florida (the two largest users of chloropicrin in the United States). Based on the available monitoring data and chloropicrin's environmental fate properties (in other words, high volatility and rapid biotransformation), the PMRA determined that levels in groundwater are expected to be minimal.

Chloropicrin applied as a soil fumigant may be transported to nearby surface water under flooded conditions. However, chloropicrin is expected to volatize quickly from surface water. Based on environmental fate data and modeling estimates, the pesticidal uses of chloropicrin are not expected to adversely impact surface water.

To minimize the potential leaching and runoff of chloropicrin, environmental hazard statements and recommended best practices are currently included on the labels of all registered soil fumigant products containing chloropicrin. As such, precautionary environmental statements pertaining to chloropicrin's potential for leaching and to conditions that may favor runoff/leaching, as well as measures to mitigate contamination of drinking water and the risk of surface runoff from treated fields (for example, mandatory GAPs related to tarp perforation and removal) are currently included on the label of the end-use products registered for use as a soil fumigant. The product label also includes direction for use statements with regards to contamination of aquatic habitats by cleaning of equipment or disposal of wastes.

Based on the above analysis, the PMRA has concluded that chloropicrin levels in surface and ground water will be minimal and residues of chloropicrin in drinking water are not considered to be of concern to human health under the current conditions of use as a soil fumigant. No further risk reduction measure beyond those currently on product labels is proposed.

4.3.2.2.2 Remedial Wood Preservation

The potential ground and surface water exposure from chloropicrin's registered use as a remedial wood preservative is expected to be minimal based on the current use pattern. Since the end-use product is injected into pre-drilled holes and sealed, chloropicrin should be contained within the pole and release into the environment is expected to be minimal. In addition, the end-use product label contains instructions to not apply chloropicrin to wood that will be used in water. On this basis, drinking water exposure to chloropicrin from its use as a remedial wood treatment is not expected to be of concern.

4.3.3 Aggregate Risk Assessment

Aggregate exposure is the total exposure to a single pesticide that may occur from food, drinking water, residential and other non-occupational sources as well as from all known or plausible exposure routes (oral, dermal and inhalation). Acute and chronic aggregate risk assessments are comprised of contributions from food and drinking water exposures. Short-term and intermediate-term aggregate risk assessments are comprised of contributions from food, drinking water and non-occupational exposure (dermal, inhalation).

Acute and chronic aggregate exposure to chloropicrin from food and drinking water was not assessed since the presence of chloropicrin in drinking water is expected to be minimal (see Section 4.3.2.2). As discussed in Section 4.3.1, there are no domestic-class end-use products containing chloropicrin registered in Canada. The potential exposure of the general population is expected to be limited to bystander exposure from the use of chloropicrin as a soil fumigant or remedial wood preservative.

Given a limited potential for bystander exposure under current conditions of use (see Section 4.3.1), the potential for short-term aggregate exposure is considered to be minimal. As dietary and bystander exposures are not expected to result in risk of concern, the risk from aggregate exposure to chloropicrin is also not expected to be of concern for currently registered uses.

4.3.4 Cumulative Effects

The *Pest Control Products Act* requires that the PMRA consider the cumulative exposure to pesticides with a common mechanism of toxicity. For the current re-evaluation, the PMRA did not identify information indicating that chloropicrin shares a common mechanism of toxicity with other pest control products. Therefore, there is no requirement for a cumulative assessment at this time.

5.0 Impact on the Environment

5.1 Environmental Fate

The following is an overview of previously reported information from REV2016-10 and REV2017-04.

Chloropicrin is a highly volatile chemical. It is stable to hydrolysis, but subject to photolysis in air and water. Chloropicrin is highly soluble in water and has low absorption in soil. Chloropicrin is subject to biotransformation and was found to be non-persistent in aerobic soil and anaerobic aquatic systems.

Volatilization is expected to be the most important route of dissipation for chloropicrin, followed by rapid photolytic degradation in the air. Chloropicrin can also potentially move to surface water through runoff. However, it is expected to volatilize rapidly from surface water.

Chloropicrin has potential for leaching to groundwater based its high solubility in water and low adsorption to soil (especially under flooded conditions). However, available monitoring data and chloropicrin's environmental fate properties (rapid degradation and high volatility) indicate that the levels in groundwater are expected to be minimal.

Based on its log *n*-octanol–water partition coefficient (log K_{ow}) value chloropicrin is not expected to bioaccummulate.

5.2 Environmental Exposure and Risk Assessment

5.2.1 Soil Fumigation

When applied as a fumigant, chloropicrin is injected into the soil and the soil is sealed to prevent its release.

Terrestrial invertebrates may be exposed to chloropicrin in treated soil. Exposure to terrestrial plants located adjacent to treated fields may occur from off-gassed chloropicrin. Terrestrial vertebrates may be exposed to volatilized chloropicrin through inhalation exposure. Because of the short direct photolytic half-life of chloropicrin in the atmosphere, dietary exposure by

ingestion of contaminated food items (such as grass and foliage contaminated from atmospheric redeposition of chloropicrin via precipitation) is not considered as a substantial route of avian or mammalian exposure to chloropicrin. Potential exposure to chloropicrin in aquatic environments may occur to a limited extent through runoff from treated fields as well as drift of volatilized chloropicrin and redeposition through precipitation to the surrounding areas.

Extensive mitigation measures were implemented in 2012 for products containing chloropicrin to further protect human health and the environment (REV2012-09). The risk reduction measures required to address potential risk to human health will also reduce ecological risks. For example, they will provide an incentive to reduce fumigant application rates and individual treatment areas, which will in turn contribute to lower exposure and risks to non-target organisms. In addition, the risk reduction measures aimed at minimizing the release of chloropicrin from treated fields (for example, GAPs, see Section 4.2.1.1) will mitigate potential environmental exposure.

Environmental hazard precautionary statements ("*Toxic to small wild mammals*" or "*Toxic to wildlife*") are also currently included on the product labels. In addition, precautionary environmental statements pertaining to toxicity to aquatic organisms, to conditions that may favor runoff/leaching, and to chloropicrin's potential for leaching, as well as measures to mitigate contamination of aquatic habitats and the risk of surface runoff from treated fields (for example, mandatory GAPs related to tarp perforation and removal) are currently included on the label of the end-use products registered for use as a soil fumigant. The product labels also include precautionary statements with regards to contamination of aquatic habitats by cleaning of equipment or disposal of wastes.

The implemented mitigation measures are expected to mitigate potential risk to terrestrial and aquatic organisms. No further risk reduction measures beyond those currently on the product labels are proposed. Minor label amendments are proposed for consistency with current PMRA environmental label statements (see Appendix III).

5.2.2 Remedial Wood Preservation

Environmental exposure to chloropicrin from its use as a wood treatment is expected to be minimal based on current conditions of use. Risk reduction measures (in other words, specific directions for use) were implemented in 2012 for chloropicrin remedial wood treatment products (REV2012-07). As such, instructions to plug the pre-drilled holes immediately after application and to not apply chloropicrin to wood that will be used in water were added to the product labels. Based on the above, environmental exposure to chloropicrin as a result of this use is not expected to be of concern.

Since chloropicrin was found to be very highly acutely toxic to freshwater fish and invertebrates, and highly acutely toxic to mammals, label statements pertaining to toxicity to these organisms are proposed for the end-use product registered for wood preservation. Other label amendments are also proposed for consistency with current PMRA environmental label statements (see Appendix III).

6.0 Value

Chloropicrin has value as a pre-plant soil fumigant and as a remedial wood preservative. Pre-plant soil fumigants are an important tool for the control of soil pests and pathogens in Canada such as insects, nematodes, bacteria, fungi and weeds, which can disrupt plant growth and production. When used as a fumigant remedial wood preservative, chloropicrin moves rapidly as a gas into treated structural timber and poles to control decay in wood.

7.0 Pest Control Product Policy Considerations

7.1 Toxic Substances Management Policy Considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances [those that meet all four criteria outlined in the policy: persistent (in air, soil, water and/or sediment), bio-accumulative, primarily a result of human activity and toxic as defined by the *Canadian Environmental Protection Act*].

During the re-evaluation process, chloropicrin was assessed in accordance with the PMRA Regulatory Directive DIR99-03[9] and evaluated against the Track 1 criteria. The PMRA has reached the following conclusions:

- The half-lives of chloropicrin in air (8 hours), soil (4.5 days), water and sediment (0.3 day: water/sediment system) are below the Track 1 criteria for these media (that is, soil and water: ≥182 days; sediment: ≥365 days; air: ≥2 days).
- The octanol-water partition coefficient of chloropicrin (log K_{ow} = 2.38) is below the Track 1 criterion (log K_{ow} ≥5).
- Therefore, Chloropicrin does not meet Track 1 criteria, and is not considered a Track 1 substance.

7.2 Formulants and Contaminants of Health or Environmental Concern

During the review process, contaminants in the technical are compared against the list in the Canada Gazette. The list is used as described in the PMRA Notice of Intent NOI2005-01[10] and is based on existing policies and regulations including: DIR99-03; and DIR2006-02[11], and taking into consideration the Ozone-depleting Substance Regulations, 1998, of the Canadian Environmental Protection Act (substances designated under the Montreal Protocol). The PMRA has reached the following conclusions:

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9 DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*.

10 NOI2005-01, *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern under the New Pest Control Products Act*.

11 DIR2006-02, *Formulants Policy and Implementation Guidance Document*.

- Based on the manufacturing process used, impurities of human health or environmental concern as identified in the Canada Gazette, Part II, Vol. 142, No. 13, SI/2008-67 (2008-06-25), including TSMP Track 1 substances, are not expected to be present in the product.

The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02[12].

8.0 Incident Reports

Since 26 April 2007, registrants are required by law to report incidents, including adverse effects to health and the environment, to the PMRA within a set time frame. As of 9 February 2017, there are 13 incident reports submitted for chloropicrin in the PMRA database.

Ten incident reports are related to the exposure of bystanders as a result of movement of chloropicrin released from soil off-site following soil fumigation. Bystanders reported respiratory effects and/or eye irritation, and the incidents were classified as minor to moderate in severity.

All of these incidents have occurred in Ontario, either in June 2012 or May 2013. Multiple individuals were affected in these incidents, and information was received from more than one source, resulting in duplication of the information in the database.

The incidents reported in May 2013 may have occurred as a result of ineffective sealing of soil following application. For other incidents, the grower may have cultivated the treated field shortly after application.[13] The incidents reported in June 2012 were likely caused by a thermal inversion which would have resulted in chloropicrin field emissions being trapped close to the ground instead of dissipating upwards towards cooler air.[14]

These incidents have occurred before the extensive mitigation measures to further protect bystanders and the environment came into force (in other words, September 2014). No incidents related to bystander exposure to chloropicrin following soil fumigation have been reported to the PMRA since the implementation of the mitigation measures.

The other three incidents have occurred in the United States. Two of these incidents (classified as a human death and domestic animal death, respectively) are related to accidental exposure in fumigated residences (not a registered use in Canada), and also involve another active ingredient, sulfuryl fluoride. The other incident was classified as human major and involved exposure to chloropicrin leaking from a train tank.

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12 DIR2006-02, *Formulants Policy and Implementation Guidance Document.*

13 Canada, 2013b, page 7.

14 Canada, 2012d, pages 7-8.

9.0 Organization for Economic Co-operation and Development Status of Chloropicrin

Canada is part of the Organisation for Economic Co-operation and Development (OECD), which groups member countries and provides a forum in which governments can work together to share experiences and seek solutions to common problems.

As part of the re-evaluation of an active ingredient, the PMRA takes into consideration recent developments and new information on the status of an active ingredient in other jurisdictions, including OECD member countries. In particular, decisions by an OECD member country to prohibit all uses of an active ingredient for health or environmental reasons are considered for relevance to the Canadian situation.

Chloropicrin is currently acceptable for use in other OECD member countries, including Australia, New Zealand and the United States.

Chloropicrin is currently not approved for use in the European Union member states. A special review of chloropicrin was initiated by the PMRA based on the European Commission decision concerning the non-approval of chloropicrin as a plant protection product in the E.U. The aspects of concern that prompt the special review were identified as potential risks to handlers, the potential for chloropicrin to leach to groundwater, the potential for long-range atmospheric transport, and potential risk to birds, mammals and aquatic organisms.

A special review decision was published in March 2017 (REV2017-04). After evaluation of available relevant scientific information related to the aspects of concern for human health or the environment, the PMRA confirmed the current registration of chloropicrin products for sale and use in Canada.

10.0 Proposed Re-evaluation Decision

The PMRA has determined that products containing chloropicrin for sale and use in Canada are acceptable for continued registration with the implementation of the proposed label amendments. These label amendments are required to further protect human health and the environment. The labels of Canadian end-use product must be amended to include the label statements listed in Appendix III. A submission to implement label revisions will be required within 90 days of finalization of the re-evaluation decision. No additional data are being requested at this time.

List of Abbreviations

ADI	acceptable daily intake
ARfD	acute reference dose
bw	body weight
kg	kilogram(s)
K_{ow}	*n*-octanol–water partition coefficient
L	litre(s)
LOAEL	lowest observed adverse effect level
mg	milligram(s)
mPa	millipascal
nm	nanometre
NOAEL	no observed adverse effect level
OECD	Organisation for Economic Co-operation and Development
pH	-log10 hydrogen ion concentration
PMRA	Pest Management Regulatory Agency
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PRVD	Proposed Re-evaluation Decision
RED	Reregistration Eligibility Decision
TSMP	Toxic Substances Management Policy
USEPA	United States Environmental Protection Agency

Appendix I Registered Pest Control Products Containing Chloropicrin as of 15 February 2017

Registration Number	Marketing Class	Registrant	Product Name	Registered Use Type	Formulation Type	Guarantee
25669	Technical	Trinity Manufacturing Inc.*	Chloropicrin Technical	-	Liquid	99%
14588	Commercial	Timber Specialties Co*	Timber Fume	Wood Treatment	Pressurized Product	99%
13477	Restricted	Great Lakes Chemical Corporation*	Terr-o-gas 67 Preplant Soil Fumigant	Pre-plant Soil Fumigant	Liquid	CPN: 32.7% MBR: 67%
25863	Restricted	Triest AG Group, Inc.*	Chloropicrin 100 Liquid Soil Fumigant	Pre-plant Soil Fumigant	Liquid	99%
28715	Restricted	Triest AG Group, Inc.*	Pic Plus Fumigant	Pre-Plant Soil Fumigant	Solution	85.1%

CPN = chloropicrin; MBR = methyl bromide

Appendix II Toxicological Endpoints for Chloropicrin Health Risk Assessments

Exposure Scenario (route and period of exposure)	Dose (mg/kg bw/day)	Study	HC or HEC and UF [a]
Acute Inhalation [b]	$BMCL_{10}$ = 73 ppb LOAEL = 100 ppb	Human Irritation Study Based on eye irritation, increased nasal nitric oxide and change in air flow	Occupational and non-occupational HC = 73 ppb UF = 1[c]
Short and intermediate-term inhalation [b] (1 day to 6 months)	NOAEL = 0.3 ppm LOAEL = 1.0 ppm	13-Week Inhalation Study in Mice Based on nasal and lung damage, increased lung weights	Non-occupational HEC = 0.008 ppm [d] UF = 30[e] Occupational HEC = 0.035 ppm [d] UF = 30[e]
Acute Dietary	NOAEL = 0.1	One-year oral study in dogs Based on gastrointestinal irritation (vomiting and diarrhea), and blood chemistry alterations	100 [f]
	ARfD = 0.001 mg/kg bw/day		
Chronic Dietary	NOAEL = 0.1	Two-year oral gavage study in rats Based on changes in the rat stomach (both sex) and increased incidence of vacuolation of periportal hepatocytes	100 [f]
	ADI = 0.001 mg/kg bw/day		
Cancer (oral, dermal, inhalation)	Chloropicrin is not considered a carcinogen		

NOAEL = no observed adverse effect level; LOAEL = lowest observed adverse effect level; ARfD = acute reference dose; ADI = acceptable daily intake

[a] UF = uncertainty factor; HEC = Human equivalent concentration; HC = Human concentration

[b] Based on USEPA, 2009b

[c] UF = 1× for interspecies extrapolation; 1× for intraspecies variation

[d] HECs differ between non-occupational and occupational scenarios because the residential HEC is based on 24-hour exposures occurring 7 days per week, whereas the occupational HEC is based on 8-hour exposures occurring 5 days per week.

[e] UF = 3× for interspecies extrapolation; 10× for intraspecies variation

[f] UF = 10× for interspecies extrapolation; 10× for intraspecies variation

Appendix III Label Amendments for End-Use Products Containing Chloropicrin

The label amendments presented below do not include all label requirements for individual end-use products, such as first aid statements, disposal statements, precautionary statements and supplementary protective equipment. Information on labels of currently registered products should not be removed unless it contradicts the above label statements.

The labels of end-use products registered in Canada must be amended to include the following statements to further protect human health and the environment.

I) The following statement must be included in a section entitled **Environmental Precautions**

For all end-use products:
Toxic to aquatic organisms, birds and wild mammals.

II) The following statements must be included in a section entitled **DIRECTIONS FOR USE**.

For the end-use product registered for wood preservation:
DO NOT contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

II) The following statements must be included in a section entitled **STORAGE**.

For all products:
To prevent contamination store this product away from food or feed.

References

Unpublished Information Provided By Registrant

PMRA Document Number	Reference
1171193	Quantitative Characterization of [^{14}C] Residues Present in Soil, Strawberries, Green Beans and Red Beets Grown Under Actual Field Conditions Following Treatment of Soil with [^{14}C]Chloropicrin. Unpublished study prepared by PTRL East, Inc. Report No. 1276. 76 pages. December 3, 1990. DACO: 6.3
1783616	1997, [CBI Removed] Product Chemistry, DACO: 2.1,2.10,2.11,2.12,2.13,2.14,2.2,2.3,2.4,2.5, 2.6,2.7,2.8,2.9
2669152	2013, Analysis and Certification of Product Ingredients in Five Batches of Chloropicrin, DACO: 2.13.3 CBI
2669154	2015, Amended Process for Producing Chloropicrin, DACO: 2.13.3 CBI
2125716	Review of US Groundwater Monitoring Data for Consideration by PMRA, Canada, October 7, 2010.

Additional Information

Published Information

PMRA Document Number	Reference
2226695	Canada, 2012a. Pest Management Regulatory Agency. Re-evaluation Note REV2012-07, Chloropicrin, Dazomet, Metam Sodium and Metam Potassium - Label Amendments for Antimicrobial Products.
2226738	Canada, 2012b. Pest Management Regulatory Agency. Re-evaluation Note REV2012-08, Chloropicrin, Dazomet, Metam Sodium and Metam Potassium - Label Improvements for Soil Fumigant Products.
2226693	Canada, 2012c. Pest Management Regulatory Agency. Re-evaluation Note REV2012-09, Label Amendments for Soil Fumigant Products Containing Chloropicrin.
2405939	Canada, 2013a. Pest Management Regulatory Agency. Re-evaluation Note REV2013-06, Special Review Initiation of 23 Active Ingredients.

2751469 Canada, 2016a. Environment and Climate Change Canada, Health Canada. Screening Assessment Report Hexachloroethane - Chemical Abstract Service Registry Number 67-72-1. April 2016.

2661411 Canada, 2016b. Pest Management Regulatory Agency. Re-evaluation Note REV2016-10, Special Review of Chloropicrin: Proposed Decision for Consultation.

2738668 Canada, 2017. Pest Management Regulatory Agency. Re-evaluation Note REV2017-04, Special Review Decision: Chloropicrin.

2648158 European Food Safety Authority, 2011. Conclusion on the peer review of the pesticide risk assessment of the active substance chloropicrin. European Food Safety Authority, 2011. EFSA Journal 2011;9(3):2084.

2648160 European Commission, 2011a. Review report for the active substance chloropicrin finalised in the Standing Committee on the Food Chain and Animal Health at its meeting on 11 October 2011 in view of the non approval of chloropicrin as active substance in accordance with Regulation (EC) No 1107/2009. Chloropicrin SANCO/11440/2011 rev.4

2648159 European Commission, 2011b. Commission Implementing Regulation (EU) No 1381/2011 of 22 December 2011 concerning the non-approval of the active substance chloropicrin, in accordance with Regulation (EC) No 1107/2009 of the European Parliament and of the Council concerning the placing of plant protection products on the market, and amending Decision 2008/934/EC.

2562864 United States, 2008a. Registration Eligibility Decision (RED) for Chloropicrin. United States Environmental Protection Agency, July 2008. EPA-HQ-OPP-2007-0350-0176

2562865 United States, 2008b. Revised Occupational and Residential/Bystander Assessment of the Antimicrobial Use (Remedial Wood Treatment) of Chloropicrin for the Reregistration Eligibility Decision (RED) Document (Phase 3 Comment Period). PC Code 081501, DP Barcode D314399. February 14, 2008.

2562866 United States, 2008c. Revised Screening Ecological Risk Assessment for the Reregistration of Chloropicrin. United States Environmental Protection Agency, 2008. EPA-HQ-OPP-2007-0350-0175

2562868 United States, 2009a. Amended Reregistration Eligibility Decision (RED) for Chloropicrin. United States Environmental Protection Agency, May 2009. EPA-HQ-OPP-2007-0350-0396

2562869 United States, 2009b. Chloropicrin: Third Revision of the HED Human Health Risk Assessment. United States Environmental Protection Agency, April 30, 2009. EPA-HQ-OPP-2007-0350-0398

2562871 United States, 2011. Chloropicrin: Addendum to the Third Revision of the HED Human Health Risk Assessment. United States Environmental Protection Agency, January 11, 2011. EPA-HQ-OPP-2007-0350-0418

2750825 United States, 2013a. Chloropicrin. Human-Health Assessment Scoping Document in Support of Registration Review. September 3, 2013. EPA-HQ-OPP-2013-0153-0003

2648161 United States, 2013b. EFED Registration Review Problem Formulation for Chloropicrin.

2750821 United States, 2014a. Chloropicrin Final Work Plan. March 2014. EPA-HQ-OPP-2013-0153-0025

2750492 United States, 2014b. Chloropicrin Registration Review Data Call-in. August 2014. EPA-HQ-OPP-2013-0153-0028

Canada, 2012d. Pest Management Regulatory Agency. 2012 Report on Pesticide Incidents. http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_corp-plan/index-eng.php

Canada, 2013b. Pest Management Regulatory Agency. 2013 Report on Pesticide Incidents http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_corp-plan/index-eng.php.